Instrument Incubator

Wide-band Millimeter and Sub-Millimeter Wave Radiometer Instrument to Measure Tropospheric Water and Cloud ICE (TWICE)

Completed Technology Project (2014 - 2017)

Project Introduction

We propose to develop, fabricate and test a new, multi-frequency millimeter and sub-millimeter-wave radiometer instrument to provide critically-needed measurements in NASA's Earth Science Focus Areas of Climate Variability & Change and Water & Energy Cycle. Specifically, the new Tropospheric Water and Cloud ICE (TWICE) instrument will address the need for measurements of water vapor and cloud ice in the upper troposphere at a variety of local times, to provide data not currently available from microwave sensors in sun-synchronous orbits. Such global measurements will enable more accurate cloud and moisture simulations in global climate models, improving both climate predictions and characterization of these models' uncertainties. Second, this capability will address the need for measurements of cloud ice particle size distribution and water content in both clean and polluted environments to investigate the effect of aerosol pollution on cloud properties and climate. This is particularly important since the uncertainty in the aerosol effect on climate is at least four times as great as the uncertainty in greenhouse gas effects. Additionally, this instrument will provide humidity and temperature profiles covering most of the troposphere in nearly all weather conditions. The TWICE radiometer instrument will advance the state of the art of sub-millimeter-wave radiometers by transitioning from Schottky mixer-based front ends to InP HEMT MMIC low-noise amplifier front ends, thereby substantially reducing the mass, volume and power consumption of space-borne radiometers. This will greatly enhance the suitability of these instruments for deployment on small satellite platforms in general, and on CubeSats in particular. The proposing team is well positioned to achieve these goals since Co-Is Drs. Deal and Kangaslahti have demonstrated world-record low-noise InP HEMT MMIC LNAs in the frequency range from 100 GHz to 670 GHz and were the first to develop a low-noise amplifier at 670 GHz. In this project, we will develop the next generation of MMIC LNAs for this frequency range. The TWICE instrument will perform water vapor and temperature sounding near multiple absorption lines from 118 to 380 GHz as well as cloud ice particle sizing at multiple window frequencies from 235 to 670 GHz. The initial technology readiness level (TRL) of the required components is 3. Over the three-year period of performance, this IIP project team will produce the TWICE instrument and demonstrate the complete system in a relevant environment, for an exit TRL of 5.

Develop, fabricate and test a wide-band millimeter and sub-millimeter wave radiometer instrument to measure Tropospheric Water and Cloud Ice Develop capability to measure upper-tropospheric water vapor, cloud ice particle size distribution and water content at a variety of local times Reduce the size, mass and power consumption of space-borne millimeter and sub-millimeter wave radiometers to enable deployment on a 6U CubeSat platform

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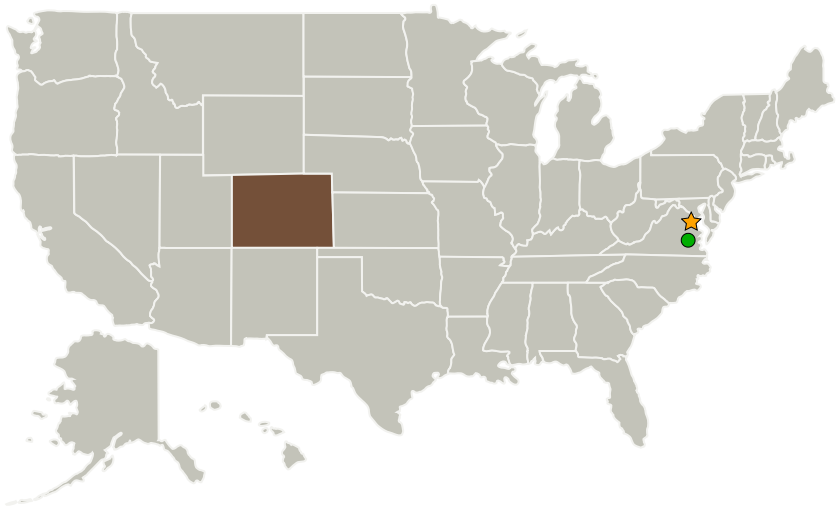
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★NASA Headquarters(HQ)	Lead Organization	NASA Center	Washington, District of Columbia
●Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations
Colorado

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Center / Facility:

NASA Headquarters (HQ)

Responsible Program:

Instrument Incubator

Project Management

Program Director:

Pamela S Millar

Program Manager:

Parminder S Ghuman

Principal Investigator:

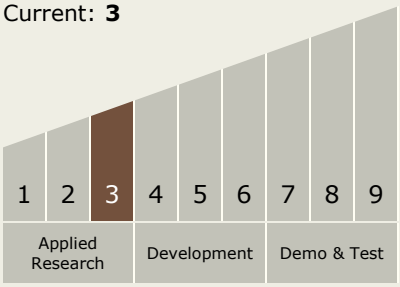
Steven Reising

Co-Investigator:

Linda Loing

Technology Maturity (TRL)

Start: **3**
Current: **3**



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Images

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(https://techport.nasa.gov/image/5113)

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.4 Microwave, Millimeter-, and Submillimeter-Waves

Target Destination

Earth